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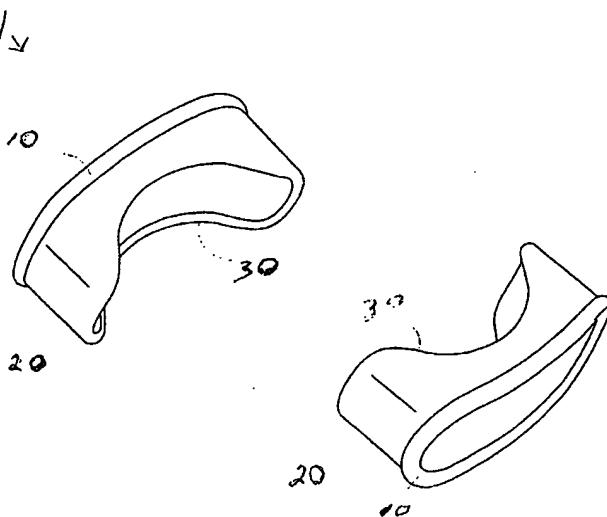
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(54) Title: MOUTHPiece DEVICES AND METHODS TO ALLOW UV WHITENING OF TEETH

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(57) Abstract: A plastic mouthpiece insert for allowing a wearer to whiten their teeth while getting a suntan, and have a generally oblong ovalrectangular opening with a curved rear end that abuts against the root surfaces of the frontal upper and lower teeth of the wearer. A raised front edge can protect the lips and separate in place about the opening to the mouthpiece. Whitening agents can be used to enhance the whitening effect so that ultraviolet light and heat source such as the sun or a sunlamp is all that it is needed. Reflective inner walls in the mouthpiece can magnify light to the teeth. The mouthpiece can include bite tables, and the side walls of the mouthpiece can be inwardly flared and funnel shaped for focusing and magnifying incoming light and heat. The mouthpiece can be colored to protect the inside of the wearer's mouth from receiving any light.

## MOUTHPIECE DEVICES AND METHODS TO ALLOW UV WHITENING OF TEETH

This invention claims the benefit of priority to United States  
5 Provisional Patent Application 60/413,049 filed September 24, 2002.

### FIELD OF USE

This invention relates to teeth whitening, in particular to plastic  
insertable mouthpieces and kits that can include whitening pastes and  
10 gels, for exposing upper and lower frontal teeth to be whitened by  
ultraviolet light while allowing the wearer of the mouthpieces to  
receive a suntan from suntan lamps and from natural sunlight.

### BACKGROUND AND PRIOR ART

15 Various professional and commercial services and products  
exist today for whitening teeth. For example, a dental professional can  
whiten teeth by creating a specific mold of an individual's teeth or by  
using a device for treating teeth. See for example, U.S. Patents:  
20 3,060,935 to Riddell; 4,376,628 to Aardse; and 5,165,424 to  
Silverman. However, these molds and devices are used to completely  
cover the teeth and must be used in combination with a chemical gel  
during treatments and often every night while sleeping for several  
months for the desired effect.

Further versions of these mouth devices have the teeth wearing molds and devices connected to power supplies where voltage and heat can also be used to enhance the whitening effect. See U.S. Patents 6,382,979 to Linquist; 6,497,575 to Zavitsanos et al.; and U.S. Patent

- 5 Application Publication to Zavitsanos et al. In addition to the problems with the molds and devices referenced above, these devices can cause harm to the patient by the effects of exposure to heat and electricity over time.

Another known service has the dental professional apply a similar chemical whitener and laser light waves to cause the some effect in a shorter amount of time, but with substantial costs. See U.S. Patent 6,361,320 to Yarborough and U.S. Patents 5,645,428 and 6,416,320 to Cipolla and assigned to Britesmile, Inc.. The method behind this is that a chemical is used to whiten teeth but for faster results, a laser light could be used but normally requires extra protection to the gums because of the harmful combination of the harmful ingredients of the paste in combination with the laser light.

In addition to the substantial added expense of using a laser light, only skilled professionals can use such equipment for whitening teeth. In addition, these types of devices require using a laser type light source that must operate in a specific range in order to work. For example, the Cipolla patents '428 and '320 require light sources that

must between 350 and 700 nm, and specifically require the need for light sources that must further emit in wavelengths between 400-520 nanometers and 450 to 530 nanometers, respectively, in order to achieve optimum whitening results.

5       Overall these professional procedures described above can generally cost hundreds to thousands of dollars and require professionals to be administered properly to patients. Additionally, the complete teeth mold and the light treatments can be uncomfortable to the patient. Still furthermore, the patient must make special  
10      appointments to have the treatments done which add to the undesirability of these services and products.

Off-the-shelf commercial products are also now available. For example, the easier and more accessible source of teeth whitening products are the over-the-counter teeth whitening products, such as  
15      toothpastes with baking powder, gels, and more recently "strips". Although these products may be more affordable than using professional dental services, these commercial products are usually not quite as effective as professional services and usually take more time to create the desired effects of whitening one's teeth.

20       Thus, the need exists for solutions to the above problems with the prior art.

SUMMARY OF THE INVENTION

The first objective of the present invention is to provide a method and device for whitening teeth that does not require professionals such as dentists, and the like to administer.

5       The second objective of the present invention is to provide a method and device for whitening teeth that is as effective as professional teeth whitening treatments and devices but is substantially safer and less expensive and easier to use.

10      The third objective of the present invention is to provide a method and device for whitening teeth that does not require the user to wear molds and devices on their teeth overnight.

The fourth objective of the present invention is to provide a method and device for whitening teeth that is more effective than simple gels and pastes used by themselves to whiten teeth.

15      The fifth objective of this invention is to provide a method and device for whitening teeth that protects the gums against harmful teeth whitening ingredients and harmful light such as UV light.

20      The sixth objective of the present invention is to provide a method and device for whitening teeth that allows the user to whiten their teeth while receiving a suntan.

The seventh objective of the present invention is to provide a method and device for whitening teeth that can use traditional sunlamps and the natural light from the sun for whitening teeth, and does not require artificial light sources such as lasers, and the like.

A preferred system and method for whitening teeth combines a mouth piece with a face end and a rear end and having an oval shape between the face end and the rear end with an oval shaped opening therethrough, the mouth piece being insertable into a mouth of a user

5 with the rear end adjacent to abut against root edges of upper and lower frontal teeth for exposing the upper frontal teeth and lower frontal teeth of the user. The system further allows for a light source for beaming light onto the exposed upper front teeth and the exposed lower frontal teeth for bleaching the exposed upper frontal teeth and

10 exposed lower frontal teeth over time and while protecting the upper and lower gums of the user from the light source..

The mouthpiece can have an elongated oval length with a concave curved rear edge for abutting against upper the lower frontal teeth root edge portions of the user. The mouthpiece can have an

15 upper half portion for pushing an upper lip of the user to expose the upper frontal teeth, and a lower half portion for pushing downward a lower lip of the user for exposing the lower frontal teeth of the user.

The front end of the mouthpiece can have a raised rounded edge for keeping the upper lip and the lower lip in an open state.

20 The mouth piece can be formed from molded plastic, and come in different colors so that the colors can further protect the insides of the mouth such as the roof of the mouth, the tongue, and the gums of the mouth from getting exposed to undesirable UV type light.

The mouthpiece can be part of a kit that can include a whitening agent for being placed on the upper and lower frontal teeth prior to the light source.

A preferred light source can be an ultraviolet heated light  
5 source that emits in the range of approximately 200nm to approximately 400nm such as a body sunlamp in a suntan spa, where the wearer of the mouthpiece can receive a suntan while whitening their upper and the lower frontal teeth.

The light source can also be natural sunlight for simultaneously  
10 tanning the user while whitening the upper and the lower frontal teeth.

Another embodiment of the mouthpiece can include reflective inner wall surfaces in the mouthpiece for magnifying effects of a light source.

A still another embodiment of the mouthpiece can include a  
15 bite tab attached to and protruding inside the mouthpiece for allowing a user to bite down on the bite tab to secure the mouthpiece in a fixed position.

A still another embodiment of the mouthpiece can include  
sidewalls flaring inwardly from the face end to the rear end so that  
20 mouthpiece can focus incoming light to substantially cover all upper and lower frontal teeth for exposure to whitening by light.

Further objects and advantages of this invention will be apparent from the following detailed description of the presently preferred embodiments which are illustrated schematically in the  
25 accompanying drawings.

BRIEF DESCRIPTION OF THE FIGURES

- Fig. 1A is a top rear perspective view of a first preferred embodiment of the mouthpiece.
- 5 Fig. 1B is a top front perspective view of the first preferred embodiment of the mouthpiece.
- Fig. 2A is a top view of the mouthpiece embodiment of Figures 1A-1B.
- 10 Fig. 2B is a front end view of the mouthpiece of Fig. 2A along arrow 2B
- Fig. 2C is a side view of the mouthpiece of Fig. 2A along arrow 2C.
- Fig. 3 shows a perspective view of a kit for the embodiment of the preceding figures that can include the mouthpiece and a tube of whitening agent.
- 15 Fig. 4 shows a front view of the mouthpiece of the preceding figures in place exposing upper and lower frontal teeth.
- Fig. 5 shows another view of Fig. 4 with a whitening agent being applied.
- Fig. 6 is a cross-sectional view of a user wearing the mouthpiece of the preceding figures while receiving whitening treatment from a light source.
- 20 Fig. 7 is a perspective view of a second embodiment mouthpiece with reflective walls.
- Fig. 8A is a top rear perspective view of a third preferred embodiment of the mouthpiece with bite tab(s).

Fig. 8B is a top front perspective view of the third preferred embodiment mouthpiece.

Fig. 9A is a top view of the mouthpiece embodiment of Figures 7-8

Fig. 9B is a front end view of the mouthpiece of Fig. 9A along arrow

5 9B

Fig. 9C is a side view of the mouthpiece of Fig. 9A along arrow 9C.

Fig. 10A is a top view of a fourth embodiment mouthpiece with inwardly flared sidewalls.

Fig. 10B is a front end view of the mouthpiece of Fig. 10A along

10 arrow 10B

Fig. 10C is a side view of the mouthpiece of Fig. 10A along arrow

10C.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

15 Before explaining the disclosed embodiments of the present invention in detail it is to be understood that the invention is not limited in its application to the details of the particular arrangements shown since the invention is capable of other embodiments. Also, the terminology used herein is for the purpose of description and not of limitation.

20 Fig. 1A is a top rear perspective view of a first preferred embodiment of the mouthpiece 1. Fig. 1B is a top front perspective view of the first preferred embodiment of the mouthpiece 1. Fig. 2A is a top view of the mouthpiece 1 of Figures 1A-1B. Fig. 2B is a front

end view of the mouthpiece 1 of Fig. 2A along arrow 2B. Fig. 2C is a side view of the mouthpiece 1 of Fig. 2A along arrow 2C.

Referring to Figures 1A, 1B, 2A-2C, mouthpiece 1 can include a front face end 10 having a slightly convex outer edge 12 with a raised 5 rounded surface ridge 14 running about face end 10 with a generally parallel upper and lower walls 16 and curved end walls 18 that together define a generally rectangular-oval shaped opening. Upper wall 17 can further be slightly curved upward to more expose upper frontal teeth of the user. The opening of the mouthpiece 1 can be 10 approximately 2 and 3/10 inches wide between curved end walls 18, with a height of approximately 9/10 of an inch to approximately 1 and 1/10 of an inch between upper and lower walls 16-16 and 17-17.

Mouthpiece 1 can include side wall portion 20 with an opening 26 matching that of the front end 10. Side wall portion 20 can have 15 thin walls of approximately 1/10 inch thick, with left side 22 being approximately 9/10 of an inch long, mid side portion 24 being approximately 4/10 of an inch long, and right side 28 being approximately 9/10 of an inch long. Rear face 30 can have generally planar left rear edge 32, a generally planar right rear edge 38 and a 20 generally concave curved rear edge 34 running between the left rear edge 32 and the right rear edge 38.

Mouthpiece 1 can be formed from molded plastic and the like, and can come in different colors such as but not limited to blue, red, clear, and the like.

The dimensions of the mouthpiece referenced above can be for an adult male size mouthpiece 1. Different dimensions can be made for mouthpieces for women and children. For example, a women's size mouth piece can include dimensions of a modified opening of 5 approximately 2 and 1/10 inches wide by approximately 7/10 to approximately 8/10 inches in height and sidewalls of approximately 6/10 to approximately 7/10 inches long.

Fig. 3 shows a perspective view of a kit 70 for the embodiment of the preceding figures that can include the mouthpiece 1 and a tube 10 50 of whitening agent. The kit 70 can include package 60 such as but not limited to a plastic see-through bag that seals a single mouthpiece 1 and a tube 50 of whitening agent inside so that a user is guaranteed a sterile version of the novel mouthpiece 1 when being used. Tube 50 can include a whitening agent such as but not limited to a gel or paste 15 with for example, approximately 21% carbamide peroxide, which can be mint flavored, and is light and heat activated.

Fig. 4 shows a front view of the mouthpiece 1 of the preceding figures in place exposing upper and lower frontal teeth 110, 120 respectively. Fig. 5 shows another view of Fig. 4 with a whitening 20 agent 50 being applied. Fig. 6 is a cross-sectional view of a user 100 wearing the mouthpiece 1 of the preceding figures while receiving whitening treatment from a light and heat source 150.

Referring to figures 4-6, mouthpiece 1 can be inserted into the mouth 105 of a user 100 so that rear face end 30 abuts against the root 25 edges 112, 122 of the upper frontal teeth 110 and the lower frontal

teeth 120 while protecting upper and lower gum areas 115, 125 of the user's mouth from being exposed to the light and heat source 150. The front end 10 of the mouth piece 1 can be pushed in so that raised rounded surface ridge 14 is able to abut against and hold back upper and lower lips 118, 128 of the user 100. The mouthpiece 1 allows light 155 to pass within the opening defined by side wall portion 20 so that upper and lower frontal teeth 110, 120 are exposed to the light and heat 155 but not any of the other areas of the interior of the mouth 105 such as but not limited to the gum areas 115, 125.

10       The novel structural shape and using a mouthpiece in different colors allows for adequate protection for the insides of the mouth such as the roof of the mouth, the tongue, and the gums of the mouth from getting exposure to undesirable UV type light sources and/or heat sources.

15       The mouthpiece 1 can easily slip into the mouth 105 between the lips 118, 128 and sits comfortable in front of the gums 115, 125, leaving the upper and lower frontal teeth 110, 120 exposed to a light 155 such as heated ultraviolet light 155 that can be emitted from a light source 150 such as a sunlamp in a tanning booth, and the like. The 20      mouthpiece 1 can be placed into the mouth 105 when the wearer 100 is entering a tanning bed or tanning apparatus.

          The novel invention can use sunlamps and ultraviolet light sources used in tanning booths and/or by sunlamps that can emit within the range of approximately 200 to approximately 400 25      nanometers, such as those sunlamps and ultraviolet lamps used in

sunlamp products for the tanning industry defined by the U.S. Food and Drug Administration. See Code of Federal Regulations Title 21, Volume 8, Sec. 1040.20 which controls regulations for the sunlamp and tanning industry.

5        In addition, the light and heat source 150 can be the natural sun which is known to emit ultraviolet light that reaches the earth surface within the range of approximately 290 to approximately 400 nanometers. See article entitled: Allen, Jeannie, Ultraviolet Radiation: How It Affects Life on Earth, Earth Observatory, NASA, September 6,

10      2001.

Unlike the prior art, the novel invention does not require the need to use expensive and elaborate and often complex to use artificial light sources such as lasers, and the like, that were described in the background of the invention.

15      After insertion of the mouthpiece 1, the wearer 100 places the front of their mouth 105 in the direction of the light source 150. The heated UV light 155 from light source 150 hits the upper and lower frontal teeth 110, 120 causing them to whiten. The light source 150 can also be the sun so that a user 100 lying under the sun during a suntan

20      can also use the novel mouthpiece 1 for whitening their teeth. The bleaching that is created by the mouthpiece 1 alone is done by the UV light source, similar to bleaching of bones. The mouthpiece 1 can be used without the whitening agent 50 over a long amount of time as compared when used with a whitening agent 50.

For enhanced and faster effects a whitening agent material 55 such as but not limited to a carbomide peroxide (different percentages) tooth whitening gel or paste can be added to cause the frontal upper and lower teeth 110, 120 to become whiter more quickly. The 5 whitening material 55 can be lightly spread on the frontal upper and lower teeth 110, 120 in conjunction with the use of the mouthpiece 1 for a faster desired effect.

Referring to Fig. 3, the mouthpiece 1, with or without the whitening agent 50 can be sold and/or distributed through tanning 10 salons where it can be used productively up to approximately two to approximately three times a week until the appropriate whiteness is created.

The invention can be used in connection with an already allotted amount of time in a tanning bed or lying on the beach or 15 anywhere else while the user 100 is getting a tan.. The mouthpiece 1 with or without the whitening agent 50 is substantially less expensive and less obtrusive than professional whitening services as described in the background section of the invention, but can have at least similar whitening effects as professional whitening services and products. The 20 novel mouthpiece 1 can be purchased by a consumer once and can be used over and over with no maintenance, other than an occasional cleaning and disinfecting. The whitening agent 50 can be repurchased individually when needed.

The novel mouthpiece 1 is structurally shaped so as not to add any undesirable creases to the lips and face when the wearer 100 is getting a suntan.

Fig. 7 is a perspective view of a second embodiment  
5     mouthpiece 200 with reflective inner walls 210 that can be a shiny insert material such as silver paint material, a glossy finish, and the like. The rest of the second embodiment mouthpiece 200 is identical to the first embodiment mouthpiece 1 previously described and can work similar the embodiment previously described. In addition the  
10    reflective inner walls 210 allow light to become magnified to increase the whitening effect on the upper and lower frontal teeth 110, 120 of the wearer 1 effectively shortening the amount of time needed to whiten the teeth. Similar t

Fig. 8A is a top rear perspective view of a third preferred  
15    embodiment of the mouthpiece 300 with bite tabs 310, 320. Fig. 8B is a top front perspective view of the third preferred embodiment mouthpiece 300. Fig. 9A is a top view of the mouthpiece embodiment 300 of Figures 7-8 Fig. 9B is a front end view of the mouthpiece 300 of Fig. 9A along arrow 9B. Fig. 9C is a side view of the mouthpiece of  
20    Fig. 9A along arrow 9C.

Referring to Figures 8A, 8B, 9A-9C, mouthpiece 300 can include horizontal tab portions 310, 320 that can be molded to protrude in a perpendicular direction inside the side wall ends 22, 28 of the side wall portion 20 of the mouthpiece 300 toward one another. The tab portions 310, 320 can also extend behind the rear end 30 of the

mouthpiece 300. Mouthpiece 300 can be made similar to and operate similar to those of the preceding embodiments. Additionally mouthpiece 300 allows the wearer the ability to bite down on the tabs 310, 320 allowing the mouthpiece to be more stable and remain 5 stationary in one position inside the mouth 105, while allowing the wearer to maintain a fixed desirable facial position for tanning as well.

Fig. 10A is a top view of a fourth embodiment mouthpiece 400 with inwardly flared sidewalls 420. Fig. 10B is a front end view of the mouthpiece 400 of Fig. 10A along arrow 10. Fig. 10C is a side view 10 of the mouthpiece 400 of Fig. 10A along arrow 10C.

Referring to Figures 10A-10C, mouthpiece 400 can be similar to and function similar to the preceding embodiments. In addition, mouthpiece 400 can include side wall portion 420 that flares inwardly between front end 10 and rear end 430 of the mouthpiece 400. The left 15 and right side walls 422, 428, and the upper and lower side walls 424, 426 can slope inwardly in a funnel type shape that can be used to allow the frontal upper and lower teeth 110, 120 to be exposed in a manner similar to the preceding embodiments. Here, the front open end 10 opening top allow light to be focused and magnified onto the frontal upper and lower teeth of the wearer. Furthermore, the inner surfaces 20 of the side wall portion 420 can include reflective surfaces to further magnify the amount of light being used for whitening.

While the invention describes the use of tanning and sunlamps used in the tanning industry, as well as the natural sun for getting both 25 a sun tan as well as whitening the teeth, the invention can be used with

other applications. For example, a face device with light source that emits similar wavelengths can be used for achieving a limited suntan of the wearer's face as well as for whitening the teeth.

Still furthermore, a light source can be made part of the front of  
5 the mouthpiece so that only the upper frontal teeth and lower frontal teeth receive the light for whitening.

While the preferred embodiments describe the use of single molded plastic for the mouthpieces, the invention can be assembled from plural pieces of plastic, and/or can be made of other materials,  
10 such as but not limited to different material compositions, wood, and coated metals, material combinations thereof, and the like.

Although the embodiments described above are described as each including separate novel features, the invention can be practiced with anyone of the embodiments using or not using novel features of  
15 the other embodiments.

While the invention has been described, disclosed, illustrated and shown in various terms of certain embodiments or modifications which it has presumed in practice, the scope of the invention is not intended to be, nor should it be deemed to be, limited thereby and such  
20 other modifications or embodiments as may be suggested by the teachings herein are particularly reserved especially as they fall within the breadth and scope of the claims here appended.

I claim:

1. A system for whitening teeth, comprising the combination of:
  - a mouth piece with a face end and a rear end and having an oval shape between the face end and the rear end with an oval shaped opening therethrough, the mouth piece being insertable into a mouth of a user with the rear end adjacent to abut against root edges of upper and lower frontal teeth for exposing the upper frontal teeth and lower frontal teeth of the user; and
- 10 a light source for beaming light onto the exposed upper front teeth and the exposed lower frontal teeth for bleaching the exposed upper frontal teeth and exposed lower frontal teeth over time and while protecting the upper and lower gums of the user from the light source..
- 15 2. The system of claim 1, wherein the mouthpiece includes:
  - an elongated oval length with a concave curved edge for abutting against the upper and the lower frontal teeth root edge portions of the user.
- 20 3. The system of claim 1, wherein the mouthpiece includes:
  - an upper half portion for pushing an upper lip of the user to expose the upper frontal teeth, and a lower half portion for pushing downward a lower lip of the user for exposing the lower frontal teeth of the user.

4. The system of claim 3, further comprising:  
a raised edge about the face end of the mouth piece for keeping  
the upper lip and the lower lip in an open state.
5. The system of claim 1, wherein the mouth piece is plastic.
6. The system of claim 1, further comprising:  
a kit including a whitening agent for being placed on the upper  
and lower frontal teeth prior to the light source.  
10
7. The system of claim 1, wherein the light source includes:  
a nonlaser ultraviolet light source that emits within the range of  
approximately 200 nm to approximately 400 nm.
- 15 8. The system of claim 7, wherein the light source includes:  
a body suntan lamp wherein the user receives a suntan while  
whitening the upper and the lower frontal teeth
9. The system of claim 7, wherein the light source includes:  
20 natural sunlight for simultaneously tanning the user while  
whitening the upper and the lower frontal teeth.
10. A method of whitening teeth, comprising the steps of:  
positioning a mouthpiece into a mouth of a user for exposing  
25 upper and lower frontal teeth of the user; and

whitening the upper and lower exposed teeth from a light source while receiving a body tan from the light source.

11. The method of claim 10, wherein the positioning step includes  
5 the step of:

placing a rear end of the mouth piece against root edges of the upper and lower teeth so that the mouthpiece protects upper and lower gums of the user during the whitening step.

10 12. The method of claim 10, wherein the positioning step further includes the steps of: pushing an upper lip of the user upward to expose the upper frontal teeth; and

pushing a lower lip of the user downward to expose the lower frontal teeth.

15

13. The method of claim 10, wherein the whitening step includes the step of:

applying ultraviolet light in a range of approximately 200nm to approximately 400nm from a nonlaser light source as the light source

20 for the body tan.

14. The method of claim 10, further comprising the step of:  
magnifying the light source by reflective walls surfaces inside  
of the mouthpiece for enhancing the whitening of the upper and the  
25 lower frontal teeth.

15. The method of claim 10, further comprising the step of:  
biting down on a bite tab attached to the mouthpiece so that the  
mouthpiece remains secure and stationary within the mouth of the  
5 user.

16. The method of claim 10, further comprising the step of:  
focusing the light source from a front end of the mouthpiece by  
inwardly flared sidewalls during the whitening step.

10

17. A mouth piece for use with whitening upper and lower frontal  
teeth within a mouth of a user, comprising:

an oblong and oval shaped frame having a face end and a rear  
end for being inserted into the mouth so that the rear end is positioned  
15 adjacent root edges of the upper and lower front teeth of the user, and  
the face end of the frame allows light to reach the upper and lower  
front teeth.

18. The mouthpiece of claim 17, wherein the rear end includes:  
20 a concave curved edge for abutting against the upper and lower  
frontal teeth root edge portions of the user.

19. The mouthpiece of claim 17, wherein the mouthpiece includes:  
an upper half surface portion for pushing an upper lip of the  
25 user to expose the upper frontal teeth, and a lower half surface portion

for pushing downward a lower lip of the user for exposing the lower frontal teeth of the user.

20. The mouthpiece of claim 19, further comprising:

5 a raised edge about the face end of the mouth piece for keeping the upper lip and the lower lip in an open state.

21. The mouthpiece of claim 17, wherein the frame is plastic.

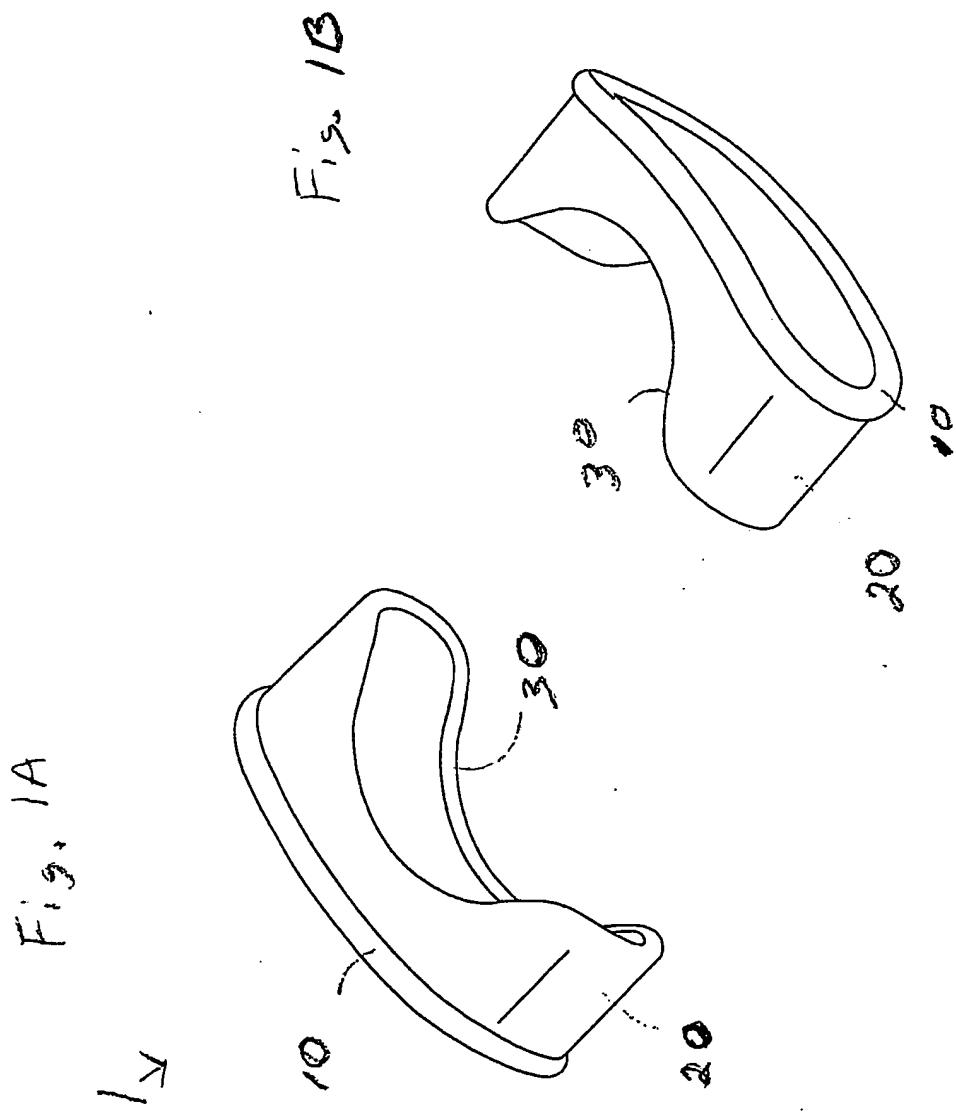
10 22. The mouthpiece of claim 17, further comprising:  
reflective inner wall surfaces in the mouthpiece for magnifying effects of a light source.

23. The mouthpiece of claim 17, further comprising:

15 a bite tab attached to and protruding inside the mouthpiece for allowing a user to bite down on the bite tab to secure the mouthpiece in a fixed position.

24. The mouthpiece of claim 17, further comprising:

20 sidewalls inwardly flaring from the face end to the rear end so the light is focused onto substantially all the upper and lower frontal teeth when whitened by the light.



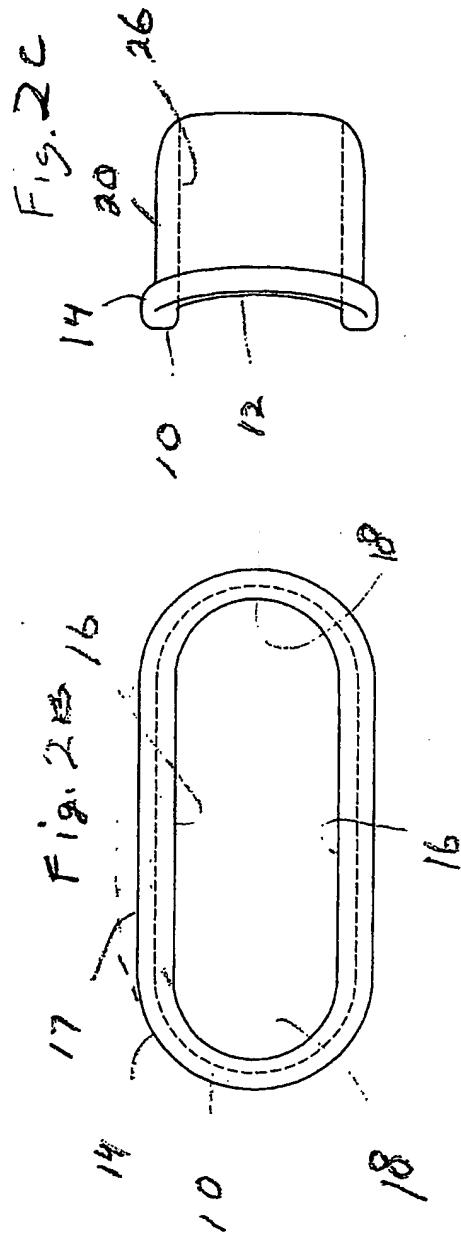
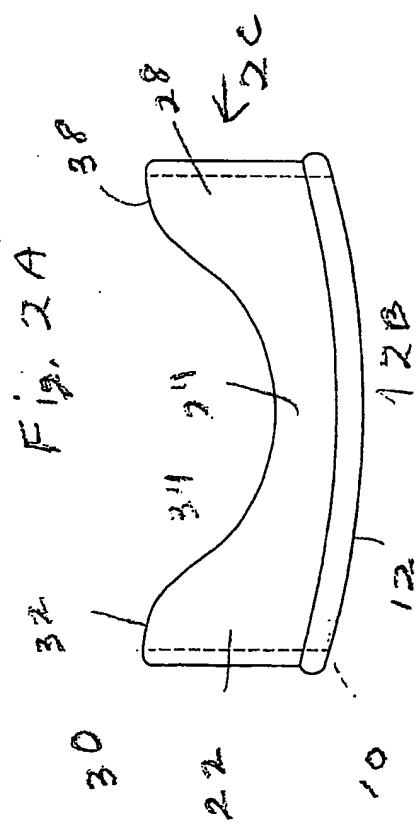
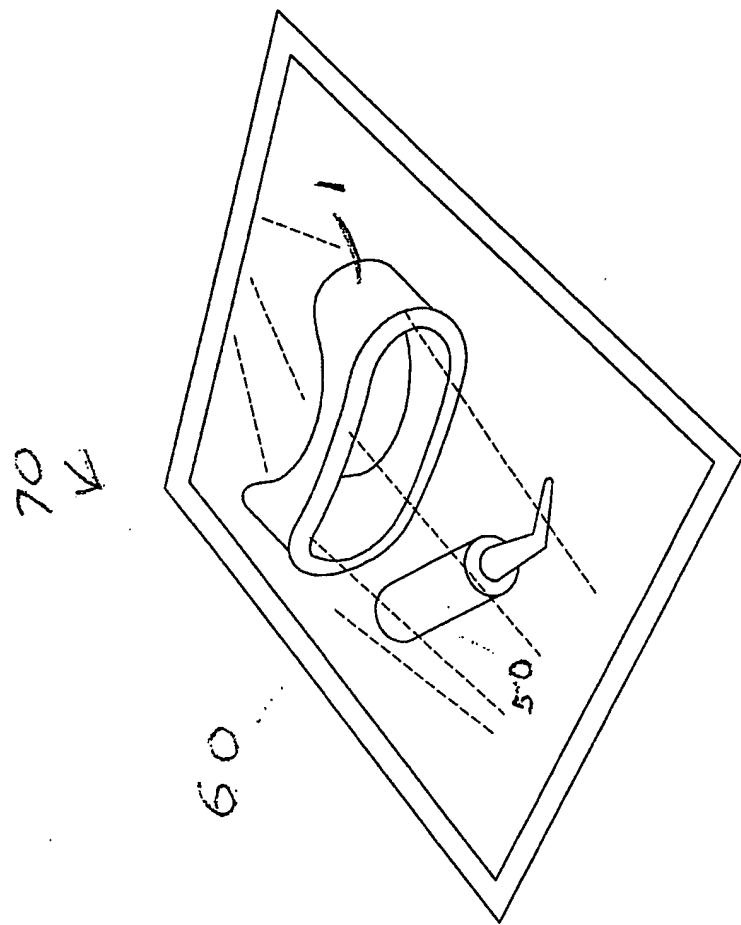


Fig.3



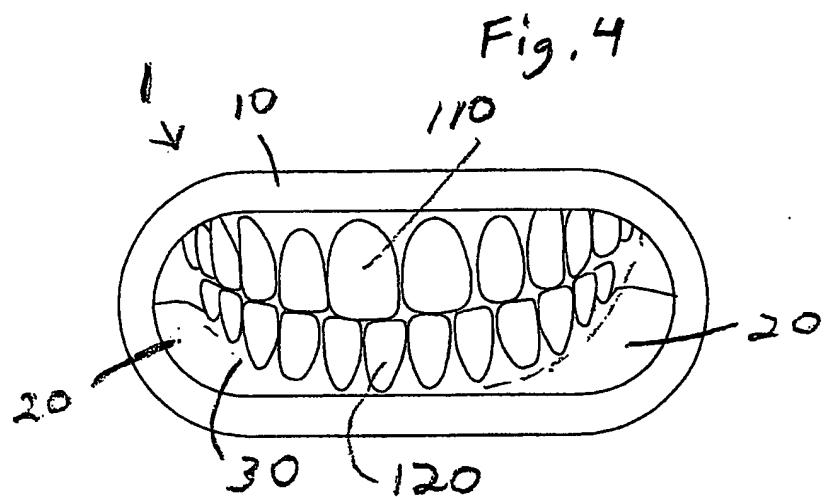


Fig. 5

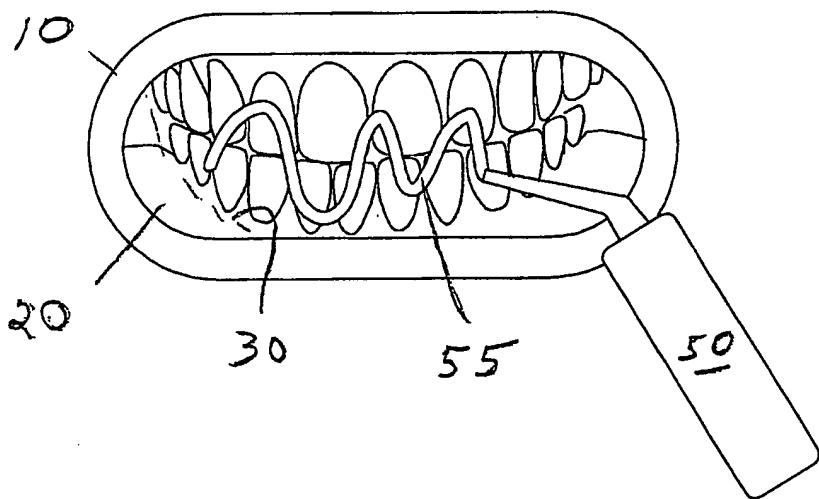


Fig. 6

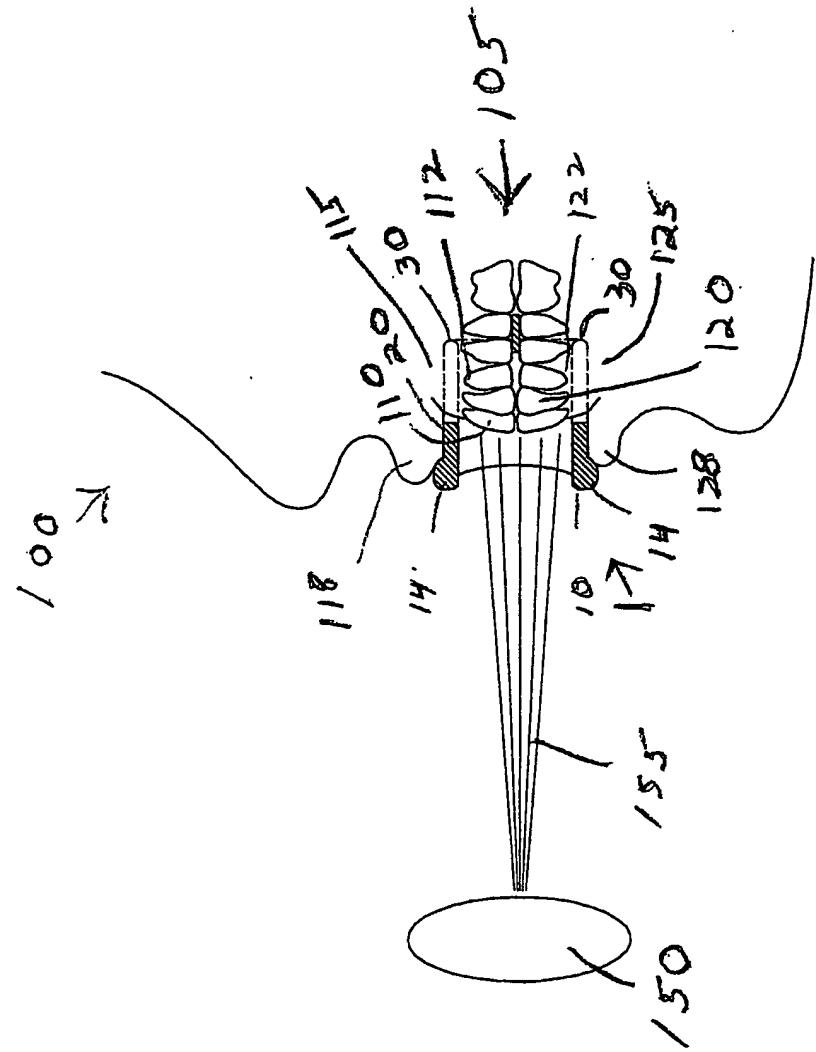


Fig. 7

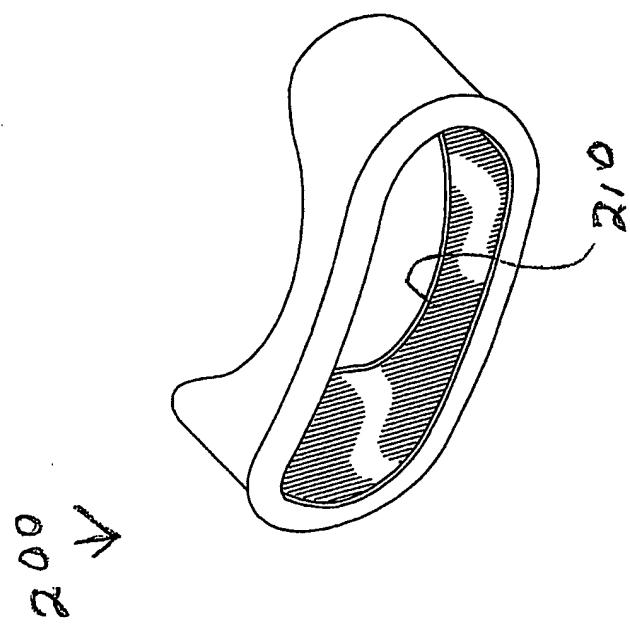


Fig. 8A

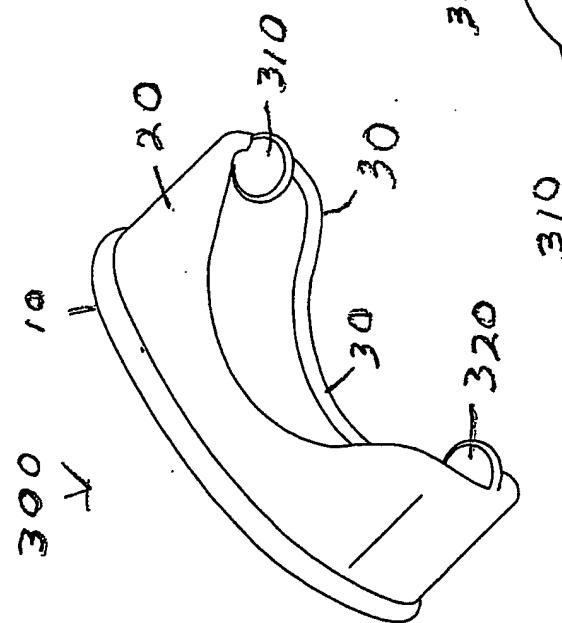
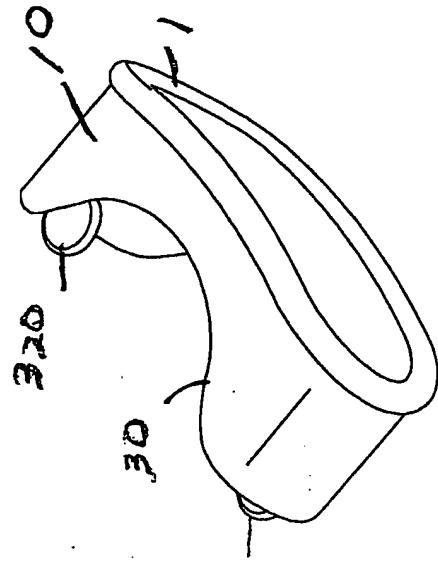
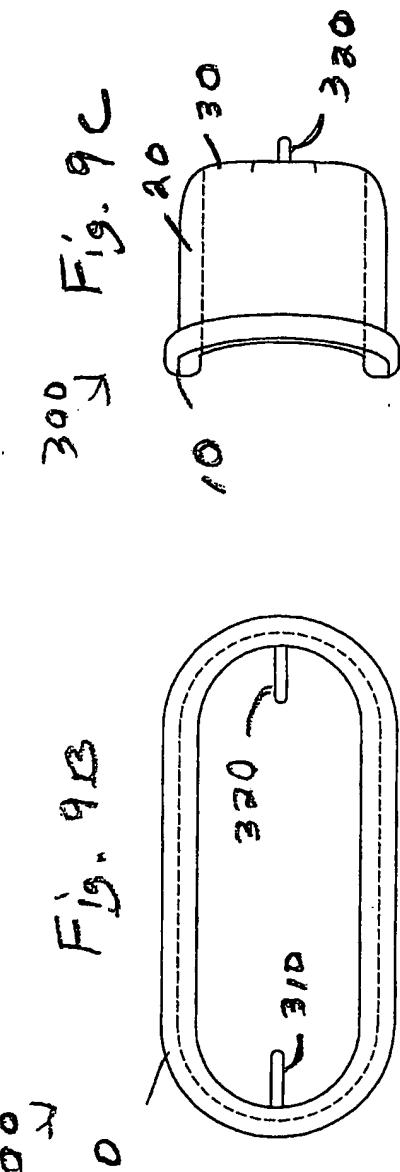
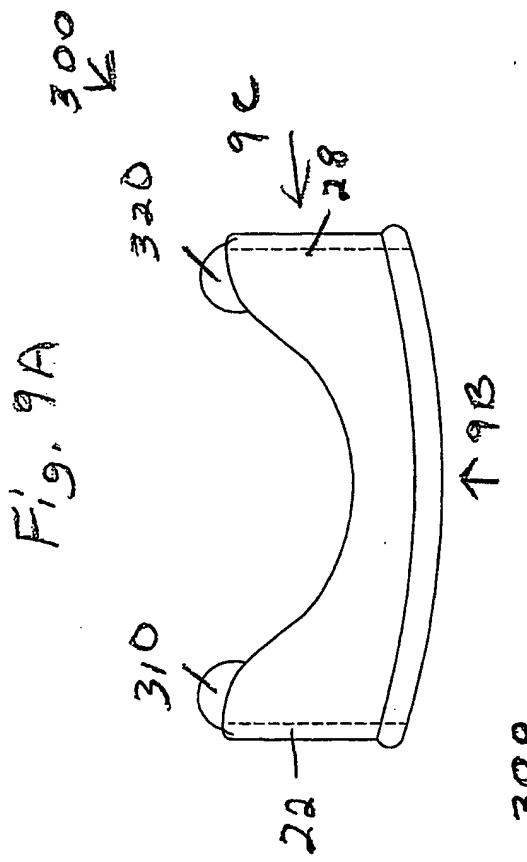
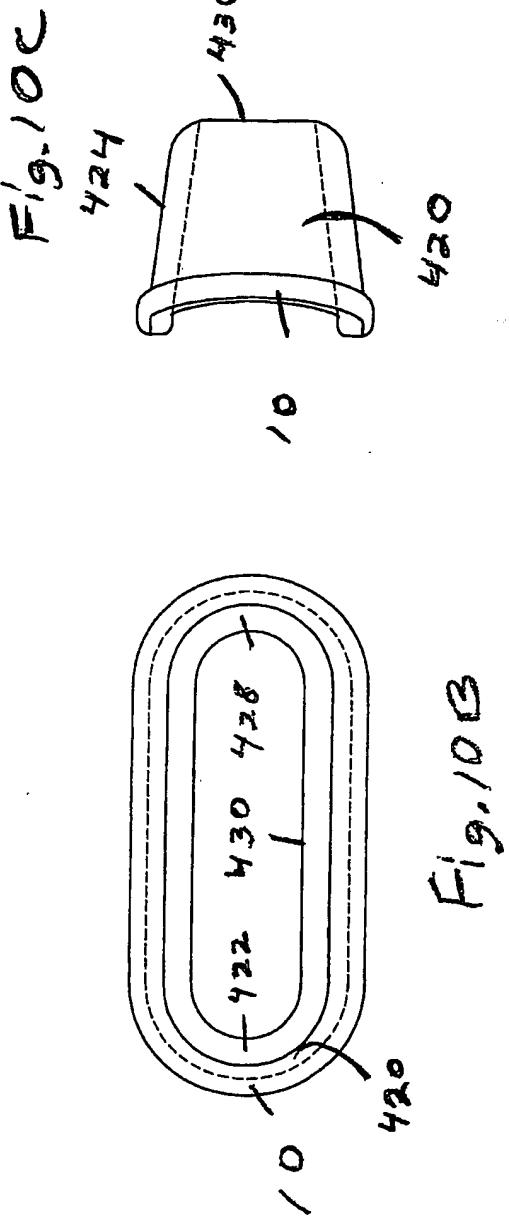
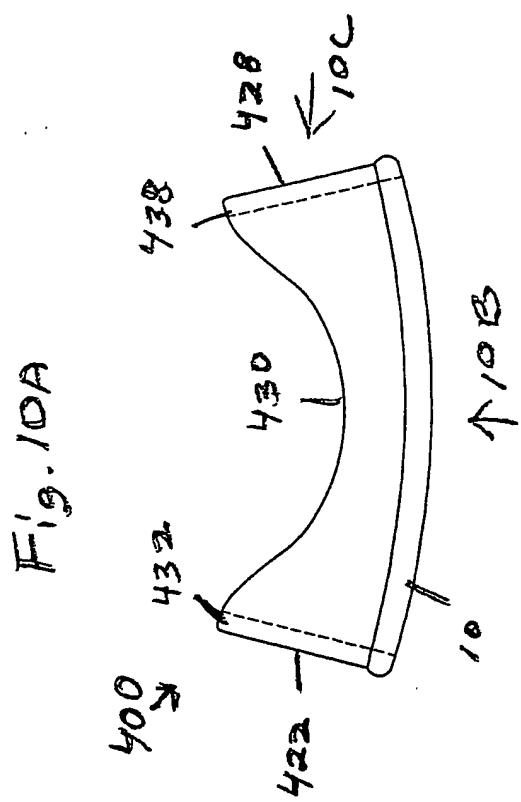


Fig. 8B







## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US03/30173

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(7) :A61C 5/00

US CL :128/861

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 128/861; 433/29, 215

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,800,165 A (KIRSCH et al) 01 September 1998, entire document.	1-24
A	US 6,391,283 B1 (JENSEN et al) 21 May 2002, entire document.	1-24
A,P	US 6,497,575 B2 (ZAVITSANOS et al) 24 December 2002, entire document.	1-24

Further documents are listed in the continuation of Box C.  See patent family annex.

* Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means		
"P" document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search

09 DECEMBER 2003

Date of mailing of the international search report

16 DEC 2003

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